



Defense Energy Support Center

Defense Energy Support Center

**Product
Technology
&
Standardization
Division**

Alternative Fuels Information Station

Fuel Ethanol (E85) Tutorial (with EPA Act 2005 Updates)



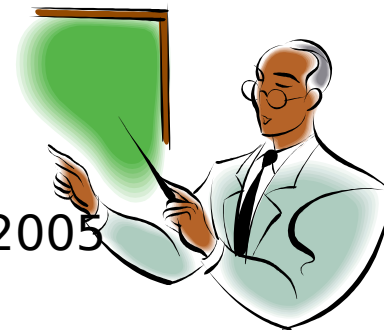


Learning Objectives



You should learn....

- The definition of ethanol fuel (E 85)
- The role of ethanol fuel as an EPLA 1992 and EPLA 2005 alternative fuel
- How ethanol and EPLA 2005 effect DoD Operations
- How ethanol fuel is made
- The advantages and disadvantages of using ethanol fuel
- Physical and chemical properties of ethanol
- The acquisition, handling and storage requirements for ethanol





Fuel Grade Definitions of Fuel Ethanol (E 85)





INTRODUCTION OF ETHANOL



PRODUCT DEFINITIONS

Pure Ethanol (E100)

Pure Ethanol (ethyl alcohol, grain alcohol) is an alcohol made from grain and other agricultural products

Ethanol Blends(Exx)

Alcohol fuel blends designated by E and followed by a number representing the percentage of alcohol (by volume) in the blend.

Examples:

- The fuel E10 is made of 10% denatured (unfit to drink) ethanol blended with 90% gasoline.
- E85, commonly called *fuel ethanol*, is made of 85% denatured ethanol blended with 15% gasoline.
- E100 is 100% denatured ethanol.





EPAct 1992, EPAct2005, and Ethanol Fuel





New Fuel Regulations



Energy Policy Act (EPAct) 2005

Energy Policy Act (EPAct) 1992

Law attempts to combat growing energy problems, provides tax incentives and loan guarantees for energy production of various types.

EO 13423

DoD Strategy

Established National Energy Policy Goals Towards Energy Security with provisions on Energy Conservation, Environmental Preservation, Petroleum Fuel Consumption, and Alternative Fuel Usage

Supercedes EO 13149 and other related laws and sets energy goals for all agencies and empowers agency heads to set up an infrastructure to enforce and monitor compliance.

Established DoD policy for procuring Alternative Fuel Vehicles and Alternative Fuels



Using Ethanol Fuel to Comply with EPAct



Energy Policy Act 2005



Energy Policy Act 1992



**E.O. 13423:
Strengthening Federal Environmental, Energy,
And Transportation Management**





EPAct 2005, E 85, and DoD



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Section 701 Federal Fleet Dual-Fuel Vehicles: Fuel Use Requirement

Requires dual fuel vehicles acquired for federal fleets applicable to the EPAct to operate solely on alternative fuels (unless a special Secretary of Energy waiver is obtained)

Section 702 Federal Fleets Incremental Cost Distribution

**Requires the US GSA and other federal agencies that procure vehicles for fleets to spread the incremental vehicle costs of all vehicles. Mandate modifies (EPAct 1992, Section 303a)-
Editorial Change**

Section 703 Alternative Compliance for State and Alternative Fuel Provider Fleets

Expands compliance options under EPAct 1992 by allowing fleets to choose a petroleum reduction path in lieu of acquiring AFVs. Interested fleets must obtain a waiver from the US Dept of Energy





EPAAct 2005, E85, and DoD



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Section 704 Review of EPAAct 1992 Programs

Requires DOE to submit a report to Congress 180 days after the enactment of this section on the number of AFVs procured and amount of alternative fuel consumed by all agencies. (Editorial Change)

Section 706 Joint Flexible Fuel/Hybrid Vehicle Commercialization Initiative

Directs DOE to establish research programs to advance the commercialization of hybrid flexible fuel vehicles. Act requires vehicles achieve 250 miles per petroleum gallon.

Section 1504 MTBE

Eliminates the federal Clean Air Act requirement for oxygenated gasoline in ozone non-attainment areas of the country. Eliminates MTBE (methyl tertiary butyl ether) by 2014





Using Ethanol (E85) Fuel to Comply with EPA Act



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Energy Policy Act 1992

E.O. 13423:

**Strengthening Federal Environmental, Energy,
And Transportation Management**

The Federal Fleet Program

EPA Act 1992

Requires that 75% of federal fleets' covered light duty vehicle acquisitions be alternative fuel vehicles (AFVs)

E.O. 13423

Sets goals for 30% reduction in greenhouse gases and 2% per year reduction in petroleum consumption by 2015.



Acquiring AFVs and using alternative fuels are integral to achieving this goal.



Using Ethanol Fuel to Comply with EPAct



E.O. 13423: Strengthening Federal Environmental, Energy, And Transportation Management

supercedes and revokes E.O. 13101, E.O. 13123, E.O. 13134, E.O. 13148, and E.O. 13149

- Reduce greenhouse gases by 3% annually through 2015 (or by 30% from year 2003 baseline) **(section 2(a))**
- Reduces consumption of petroleum products by 2% annually through end of year 2015.
- Increase total fuel consumption that is non-petroleum based by 10%
- Use hybrid vehicles where commercially available **(section 2(g))**





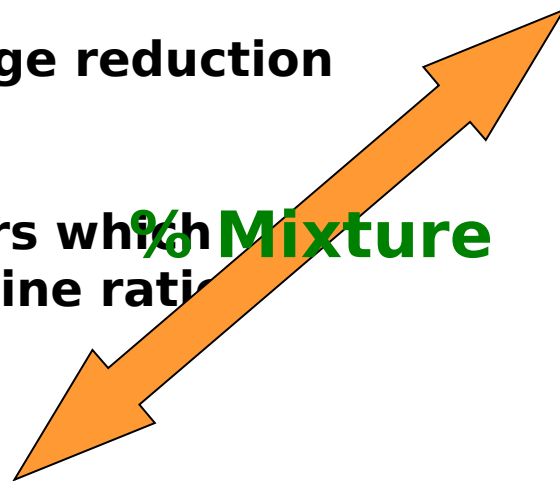
Ethanol and Flexible Fuel Vehicles (FFVs)



What is a FFV?

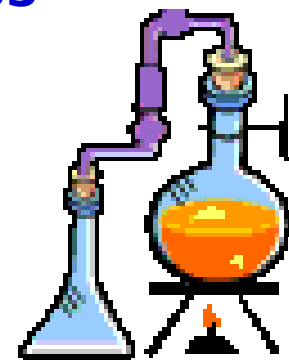
- FFVs are specially designed to run on all ethanol blends up to 85%
- FFVs can use any mixture of gasoline or E85
- FFVs observe a mileage reduction on E85 vs. gasoline
- FFVs have fuel sensors which monitor ethanol/gasoline ratio

**All
Gasoline**



All E85

% Mixture



Source: **National Ethanol Vehicle Coalition**



How is Fuel Ethanol Made?

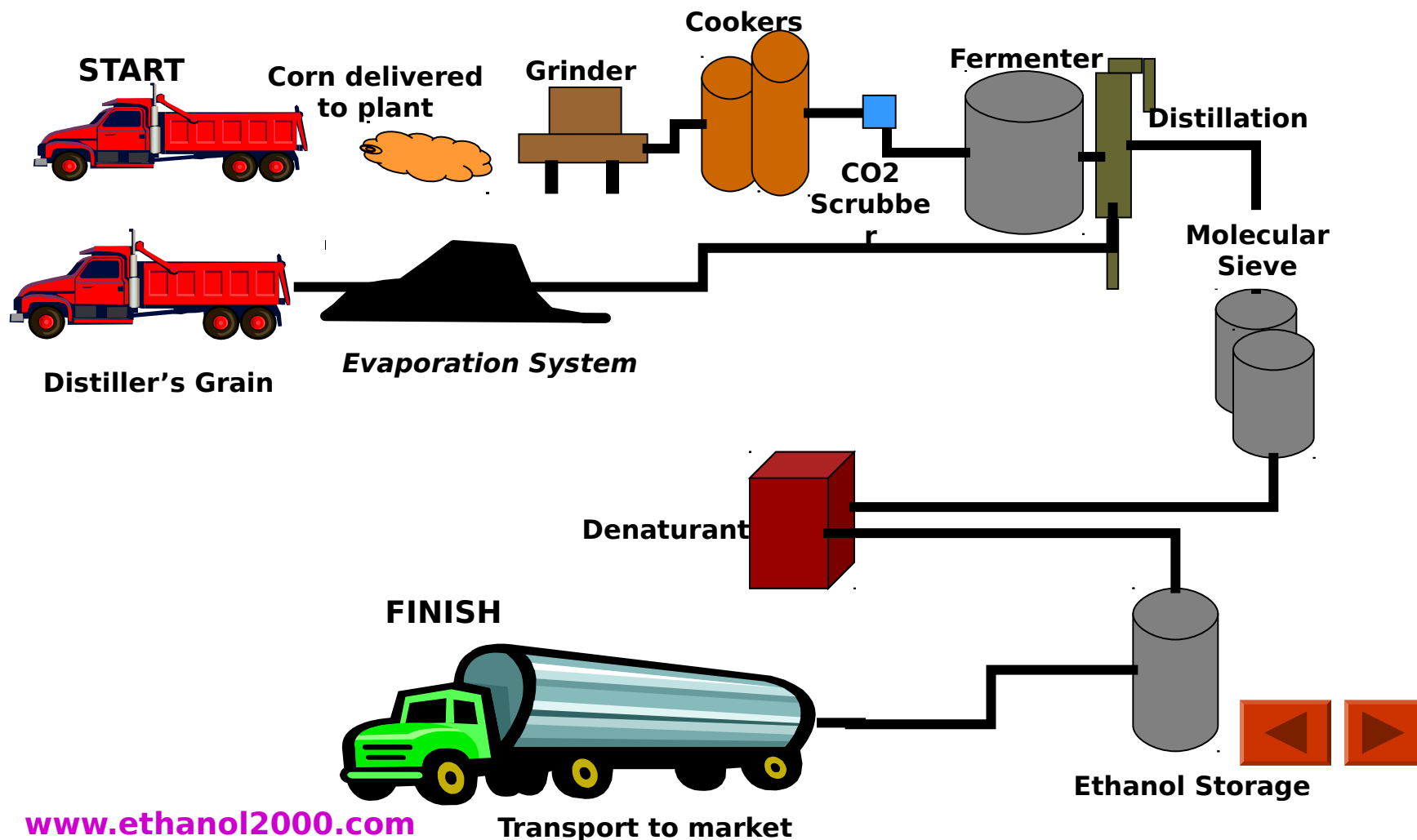




How is E85 Made?



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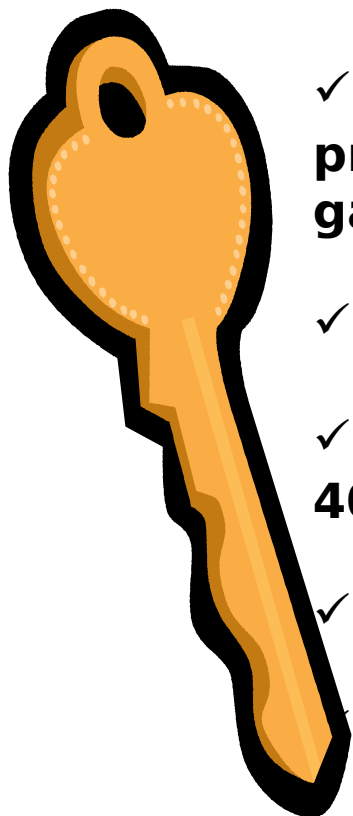




Key Advantages of E85

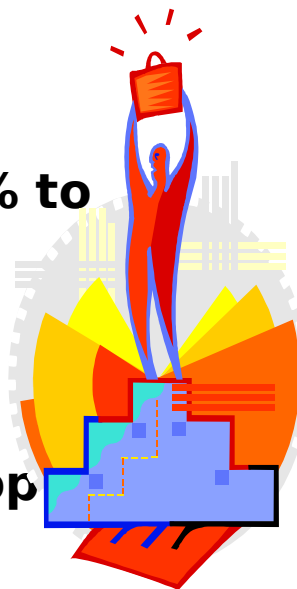


- ✓ **Flexible Fuel Vehicles (FFV) are cost equivalent to gasoline vehicles**
- ✓ **Original Equipment Manufacturers (OEMs) produce and warranty FFVs similarly to gasoline vehicles**
- ✓ **Reduces smog forming pollutants by 25%**
- ✓ **Reduces greenhouse gas emissions by 35% to 40%**
- ✓ **Increased vehicular horsepower by 5%**



Renewable fuel made from agricultural crop

Source: National Ethanol Vehicle Coalition, E85
Presentation, Jan. 9, 2001





Present Limitations of E85



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- X Reduces miles/gallon vs. gasoline**
- X Still available in limited quantities**
- X Limited distribution capabilities**



Source: National Ethanol Vehicle Coalition, E85 Presentation, Jan. 9, 2001





Ethanol Fuel Properties





Ethanol Properties



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Ethanol & E85 vs. Gasoline

Property	Ethanol	Gasoline (87 Octane)	E85
Octane (R+M)/2	98-100	86-94	96
Lower Heating Value(Btu/lb)	11,500	18,000-19,000	12,500
Gallon Equivalent	1.5	1	1.4
Miles per Gallon vs. Gasoline	70%	100%	72%
Relative tank size to yield (Driving range equivalent to gasoline)	Tank is 1.5 times Larger	1	Tank is 1.4 times Larger
Reid Vapor Pressure (PSI)	2.3	8 to 16	6 to 12
Specific Gravity (@ 60/65 F)	0.794	.72-.78	0.78
Cold Weather Starting	Poor	Standard	As good as gasoline
Vehicle Power	5% Increase	Standard	3%-5% Increase
Air/Fuel Ratio (by weight)	9	14.7	10





Ethanol/E85 Properties



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Ethanol Fuel Properties vs. Gasoline Fuel Properties

Property	Analysis
Vapor Density	Ethanol vapor and gasoline vapor are denser than air and settles in low areas: ethanol vapor disperses quicker
Solubility in Water	E85 will mix with water up to certain concentrations where it actually separates
Energy Constant	At equal volumes, E85 contains less energy than gasoline (approx .72)
Flame Visibility	Ethanol Fuel flames are less bright than gasoline, but still very visible in daylight
Specific Gravity	Pure ethanol and blends are heavier than gasoline
Conductivity	Ethanol and Ethanol Blends are conductors: Gasoline is an insulator
Fuel-to-Air Ratio	E85 needs more fuel per pound of air relative to gasoline; E85 therefore cannot be used in conventional vehicles
Toxicity	Ethanol has no carcinogenic compounds; E85 is a blend which is potentially carcinogenic
Flammability	At low temps (32 F), E85 is more flammable than gasoline. At normal temps, E85 is less flammable (because of higher auto-ignition temp.)

Source: DOE: Handbook for Handling, Storing, and Dispensing E85





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E85 Specifications

ASTM D5798-99 Standard Specification for Fuel Ethanol (Ed75E85) For Automotive Spark-Ignition Engines

Property	Value for Class			Test Method
ASTM volatility class	1	2	3	N/A
Ethanol, plus higher alcohols (minimum volume %)	79	74	70	ASTM D5501
Hydrocarbons (including denaturant) (volume %)	17-21	17-26	17-30	ASTM D4815
Vapor pressure at 37.8°C				
kPa	38-59	48-65	66-83	ASTM D4953, D5190, D5191
psi	5.5-8.5	7.0-9.5	9.5-12.0	
Lead (maximum, mg/L)	2.6	2.6	3.9	ASTM D5059
Phosphorus (maximum, mg/L)	0.3	0.3	0.4	ASTM D3231
Sulfur (maximum, mg/kg)	210	260	300	ASTM D3120, D1266, D2622
Methanol (maximum, volume %)		0.5	N/A	
Higher aliphatic alcohols, C3-C8 (maximum volume %)		2		N/A
Water (maximum, mass %)		1.0		ASTM E203
Acidity as acetic acid (maximum, mg/kg)		50		ASTM D1613
Inorganic chloride (maximum, mg/kg)		1		ASTM D512, D7988
Total chlorine as chlorides (maximum, mg/kg)		2		ASTM D4929
Gum, unwashed (Maximum, mg/100 mL)		20		ASTM D381
Gum, solvent-washed (maximum, mg/100 mL)		5.0		ASTM D381
Copper (maximum, mg/100 mL)		0.07		ASTM D1688
Appearance	Product shall be visibly free of suspended or predipitated contaminants (shall be clear and bright).			Appearance determined at ambient temperature or 21°C (70°F), whichever is higher.

N/A = Not applicable

Source: DOE: Handbook for Handling, Storing, and Dispensing E85





Ethanol Fuel Acquisition, Handling and Storage Requirements





DESC Fuel Introduction Process (Fuel Logistics)



For Over
60 Years

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Acquisition Processes

Handling & Storage Processes

Quality Assurance & Forecasting Processes

- Legislative Regulations
- Fuel Specification
- Procurement Education
- Quality Management

- Compatibility of existing Infrastructure
- Tank Cleaning & Prep
- Storage Requirements
- Quantity Measurements
- Quality Measurement

- Long term quality
- Ordering Strategy
- Distribution





How Do I Acquire Alternative Fuels from DESC?



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DESC buys fuel and energy products for both

Military and Federal Civilian Agencies



Military groups submit Requirements to Service Energy Offices



Federal agencies submit requirements directly to DESC





What Should The Requirements Document Include?



At A
Minimum:



Location

Current Point of Contact



Projected Annual Usage (Gallons)



Number & size of Tanks



Preferred Method of Delivery



Frequency of Deliveries





How Does DESC Purchase Alternative Fuels?



DESC consolidates requirements by Geographic regions designated as Customer Organized Groups (COGs)



Prepares solicitation packages and Advertises to potential suppliers



Suppliers bid on the entire region or specific line items





Ground Fuels Division (DESC-PE/PL)



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Customer Organized Groups (COGs)



Ground Fuels Division I (DESC-PE)
COGs 2, 3 and 4
Commercial Phone:
703-767-9509 DSN: 427-0500

Ground Fuels Division II (DESC-PL)
COGs 6, 7, 8, Alaska,
Hawaii & Puerto Rico
Commercial Phone: 703-767-9521 DSN: 427-9521

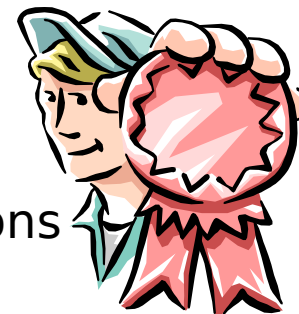


Solicitation Package Contents

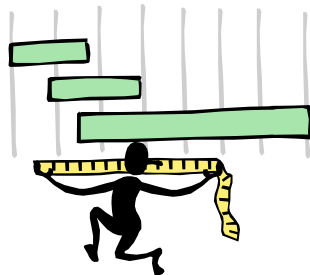
Informs potential suppliers of the terms and conditions for bidding including.....



Fuel Specifications



Quality Assurance Provisions



Quantity Measurements



Delivery Requirements



Points of Contact





DESC Fuel Introduction Process (Fuel Logistics)



For Over 60 Years
Quality

**Assurance
&
Forecasting
Processes**

**Acquisition
Processes**

**Handling
&
Storage
Processes**

- Legislative Regulations
- Fuel Specification
- Procurement Education
- Quality Management

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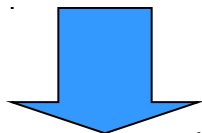
E85 Fuel Management



In many cases, existing, gasoline, diesel, or other hydrocarbon fueling systems are suitable to store and dispense E85

Use of Existing Fueling Systems

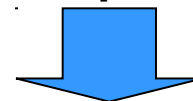
Many metal and fiberglass tanks which meet EPA codes, Dec. 98 are compatible with E85



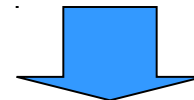
Fiberglass tanks manufactured before 1992 **MAY NOT** be able to store E85

Preparing Existing Fueling Systems

DO NOT use plated steel tanks!!!



Tank cleaning is required to remove gasoline particulates.



The cleaning technique chosen will depend on the previous fuel stored and the condition of the tank

Contaminated fuel is the most common source of operational problems with E85!!!

Source: http://www.e85fuel.com/pdf/e85_technical_booklet.pdf





DESC Fuel Introduction Process (Fuel Logistics)



Acquisition Processes

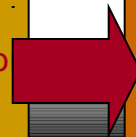
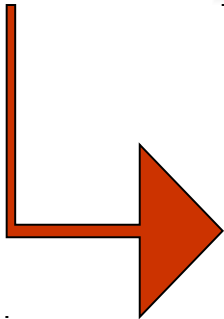
- Legislative Regulations
- Fuel Specification
- Procurement Education
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Handling & Storage Processes

- Compatibility of existing Infrastructure
- Tank Cleaning & Prep
- Storage Requirements
- Quantity Measurements
- Quality Measurement

Quality Assurance & Forecasting Processes

- Long term quality
- Ordering Strategy
- Distribution





How does the government determine the quantity of a fuel delivery?

Government Determination

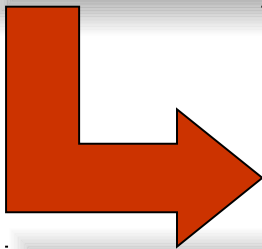


DESC ground fuel customers receive fuels by 3 transportation modes:

Transport Truck with meter

Truck & Trailer with meter

Tank Wagon (equipped with meter by default)



Receiving government entity determines fuel quantity

1. Meter measurement

OR

2. Weight (using calibrated scales)

OR

3. Calibrated meter on receiving tank system



Note: Quantity measurement and delivery conditions are defined in F1.01-1 ***“Delivery Conditions for Transport Trucks and Trailers, and Tank Wagons”*** in DESC Ground Fuel Contracts.



How does the government determine the quantity of a fuel delivery?



Contractor Determination

Contractor may determine fuel quantity by:

1. Calibrated meter on the delivery conveyance

OR

2. Gauging the delivery conveyance

OR

3. Certified receiving tank markers

OR

4. Load rack meter or calibrated scales



Note: Quantity measurement and delivery conditions are defined in F1.01-1 ***“Delivery Conditions for Transport Trucks and Trailers, and Tank Wagons”*** in DESC Ground Fuel Contracts.



Quality Assurance Requirements



Contractor Quality Activities



Alternative Fuels are supplied under Posts, Camps and Stations (PC&S) FOB Destination Contracts



Quality Assurance criteria and responsibilities are defined in E Clauses of the contract



Contractors are responsible for having a Quality System and product Quality assurance including maintaining records, sampling and testing of product





Quality Assurance Requirements



Government Quality Activities



Government Inspection and Acceptance are usually by receiving activities at destination



Receiving locations should report delivery and quality problems to contracting officer and quality problems to DESC-BQ



Contractor may be required to submit samples to government laboratory



Government reserves right to perform quality inspections at all times



Alternative fuels are commercial products and there is no government inspection at the vendor facilities





Handling & Storage Strategy



Gasoline/ Ethanol Fuel (E85)

Standard gasoline is refined or blended to be consumed with minimum storage time.

Gasoline intended for extended storage requires additives which improve storage quality



E85 is handled and stored in a manner consistent with Gasoline; however, Fuel operating equipment and materials should be evaluated for compatibility.



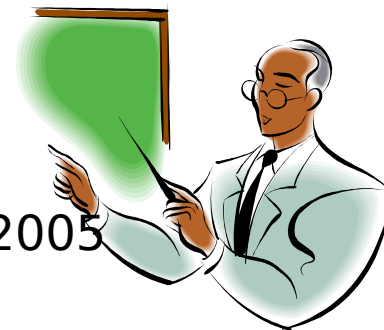


Summary



You should learn....

- The definition of ethanol fuel (E 85)
- The role of ethanol fuel as an EPCA 1992 and EPCA 2005 alternative fuel
- How ethanol fuel and EPCA 2005 affect DoD Operations
- How ethanol fuel is made
- The advantages and disadvantages of using ethanol fuel
- Physical and chemical properties of ethanol
- The handling and storage requirements for ethanol (logistics)





Frequently Asked Questions



What is E-85?

E85, commonly called *fuel ethanol*, is made of 85% denatured ethanol blended with 15% gasoline.

Why do I need to use E-85?

Energy Policy Act (EPAAct) 2005

Energy Policy Act (EPAAct) 1992

EO 13423

DoD Strategy

These documents all call for use of alternative fuels in vehicles.



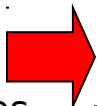


Frequently Asked Questions

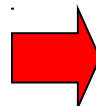


How do I acquire E-85 in DOD's logistics system?

DESC buys fuel and energy products for both Military and Federal Civilian Agencies



Military groups submit Requirements to Service Energy Offices



Federal agencies submit requirements directly to DESC

What are storage and handling requirements for E-85?

E85 is handled and stored in a manner consistent with Gasoline; however, fuel operating equipment and materials should be evaluated for compatibility.





Frequently Asked Questions



How do I know if my vehicle can use E-85?

E85 is not gasoline, but rather an alternative fuel comprised of 85% ethanol / 15% unleaded gasoline for use in Flexible Fuel Vehicles (FFVs). These vehicles are truly “flexible” in that their owners have a choice whether to use E85, any blend of ethanol up to that 85% level, or straight unleaded gasoline. On some models this comes as an option, and on some it is a standard feature. To identify whether a vehicle is flexible fuel, check the owners manual and inside the gas cap.

Can my vehicle run on E85 even if it's not an FFV?

If your vehicle is not an FFV, use of any higher ethanol percentage than 10% is not covered by warranty. People have reported that they blend higher percentages of ethanol in regular, unmodified vehicles.





Frequently Asked Questions



Can I convert my vehicle to use E85?

In theory, it is possible; in reality, it is difficult. A vehicle could be converted to operate on E85, but the challenge would be converting it to be a truly flexible fuel vehicle, one that could operate on any blend of fuel up to the 85% ethanol .

What is a Flexible Fuel Vehicle?

Flexible Fuel Vehicles, also known as FFVs, are designed to run on gasoline, E85, or any combination of the two. The “Flexible” nature of the vehicle gives the driver the flexibility to switch back and forth between gasoline and E85. How can this be?

Ethanol contains more oxygen than gasoline. The vehicles come equipped with an oxygen sensor which determines the amount of ethanol in the fuel at any time. It provides this information to the onboard computer, which then adjusts the engine to maximize efficiency and performance. The fuel may contain anywhere from zero to 85% ethanol. FFVs are widely available and include sedans, minivans, SUVs, and pickup trucks.





Frequently Asked Questions



What happens if I accidentally put E85 in my gas-only vehicle

If your vehicle is not a flexible fuel vehicle, and you accidentally use E85 you should consult your nearest dealer or repair shop. The primary difference between a flex-fuel vehicle (FFV) and a gasoline-powered vehicle is that their computer modules are meant to read different amounts of oxygen within the fuel. E85 contains a higher amount of oxygen than gasoline, and E85-compatible vehicles are made to read that higher amount.

When a gasoline-powered vehicle reads a higher amount of oxygen, your "check engine light" may appear. The vehicle should run the same as it would with gasoline. Fill up with unleaded the next time you're at the pump. Long-term use of E85 is not recommended for standard gasoline engines.





Additional Resources



GSA offers Alternative Fuel Vehicles (AFVs) to assist in meeting federal acquisition requirements

<http://gsa.gov>

The National Ethanol Vehicle Coalition

<http://www.e85fuel.com/e85101/faq.php>

